

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : H03G 3/20	A1	(11) International Publication Number: WO 96/12343
		(43) International Publication Date: 25 April 1996 (25.04.96)

(21) International Application Number: **PCT/GB95/02409**

(22) International Filing Date: **12 October 1995 (12.10.95)**

(30) Priority Data:
9420843.6 **15 October 1994 (15.10.94)** **GB**

(71) Applicant (for all designated States except US): **NOKIA TELECOMMUNICATIONS OY (FI/FI); P.O. Box 44, Uusierikku 1, FIN-02601 Espoo (FI).**

(72) Inventor; and

(75) Inventor/Applicant (for US only): **CLIFFORD, Paul, Thomas [GB/GB]; 48 Aldershot Road, Fleet, Hampshire GU13 6UT (GB).**

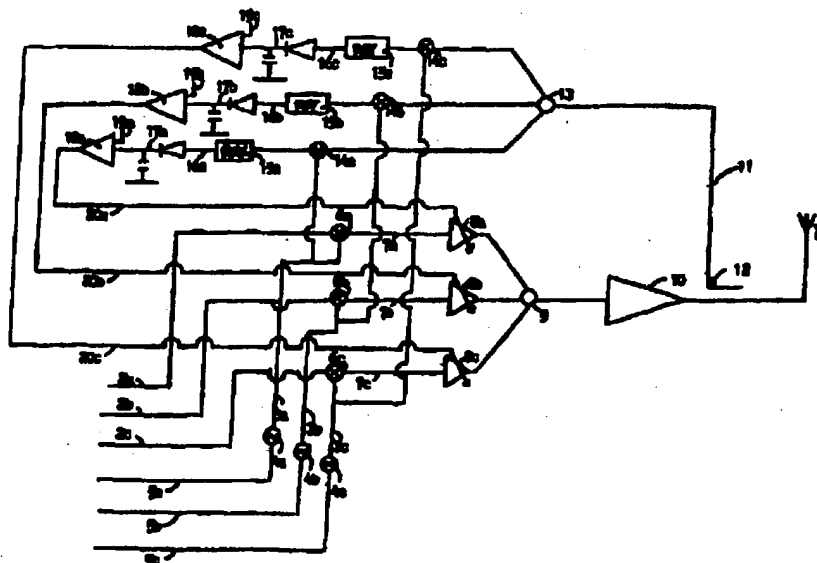
(74) Agent: **MORTON, Colin, David; Keith W. Nash & Co., Pearl Assurance House, 90-92 Regent Street, Cambridge CB2 1DP (GB).**

(81) Designated States: **AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LT, LU, LV, MD, MG, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TT, UA, UG, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, MW, SD, SZ, UG).**

Published

With international search report.

(54) Title: **TRANSMITTERS FOR RADIO TELEPHONE BASE STATIONS**



(57) Abstract

A multi-channel transmitter has a variable gain preamplifier (8a, 8b, 8c) for each channel, the combined outputs being fed to a linearised multi-channel power amplifier (10). The output of the latter is sampled by coupling means (12) which produce a sampled signal representative of the power in each channel. The sampled signal is applied to a frequency selective feedback loop which, for each channel, provides a control signal (20a, 20b, 20c) applied to the corresponding preamplifier (8a, 8b, 8c) to vary the gain of the latter in order to provide separate power control for each channel.

BEST AVAILABLE COPY

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	GB	United Kingdom	MR	Martinique
AU	Australia	GE	Georgia	MW	Malawi
BB	Barbados	GN	Guinea	NE	Niger
BE	Belgium	GR	Greece	NL	Netherlands
BF	Burkina Faso	HU	Hungary	NO	Norway
BG	Bulgaria	IE	Ireland	NZ	New Zealand
BJ	Benin	IT	Italy	PL	Poland
BR	Brazil	JP	Japan	PT	Portugal
BY	Belarus	KE	Kenya	RO	Romania
CA	Canada	KG	Kyrgyzstan	RU	Russian Federation
CF	Central African Republic	KP	Democratic People's Republic of Korea	SD	Sudan
CG	Congo	KR	Republic of Korea	SE	Sweden
CH	Switzerland	KZ	Kazakhstan	SI	Slovenia
CI	Côte d'Ivoire	LI	Liechtenstein	SK	Slovakia
CM	Cameroun	LK	Sri Lanka	SN	Senegal
CN	China	LU	Luxembourg	TD	Chad
CZ	Czechoslovakia	LV	Latvia	TG	Togo
DE	Germany	MC	Monaco	TJ	Tajikistan
DK	Denmark	MD	Republic of Moldova	TT	Trinidad and Tobago
ES	Spain	MG	Madagascar	UA	Ukraine
FI	Finland	ML	Mali	US	United States of America
FR	France	MN	Mongolia	UZ	Uzbekistan
GA	Gabon			VN	Viet Nam

TITLE: TRANSMITTERS FOR RADIO TELEPHONE BASE STATIONS

This invention relates to transmitters for radio telephone base stations, particularly base stations for digital cellular systems such as those operating according to the standard known as GSM.

This invention is concerned with power control of a plurality of radio channels in a single transmitter. Conventional power control loops are not frequency selective and are therefore not suitable for controlling the power output of a number of channels in a single transmitter.

According to the invention there is provided a transmitter for a radio telephone base station, the transmitter being operative to transmit radio signals on at least two channels, the transmitter comprising a variable gain preamplifier for each channel, combining means for combining the outputs of the variable gain preamplifiers, a multichannel power amplifier for amplifying the output of the combining means, coupling means for sampling the output of the multi-channel power amplifier and for obtaining a sampled signal representative of the output power on each channel, and a feedback loop for applying to each variable gain preamplifier a control signal which is derived from the said sampled signal, whereby the gain of each preamplifier is varied in dependence upon the power level of each channel at the output of the multichannel power amplifier.

Hence, by recourse to the invention a novel control loop is applied around the multichannel power amplifier.

A transmitter according to the invention will now be described, by way of example, with reference to the accompanying drawing which is a block circuit diagram of the transmitter.

Referring to the drawings the transmitter forms part of a base station in a radio telephone system, such as a digital cellular system, eg one operating according to the GSM standard. The base station communicates with portable handsets, and the transmitted output is radiated from an antenna 1.

The transmitter has three channels and the information to be transmitted is carried on respective baseband signals 2a, 2b, 2c at 67 KHz. In this example, the information is carried by a modulation system known as Gaussian Minimum Shift Keying, but other modulation systems may be used. To the three base band signals are added respective high frequency signals 3a, 3b, 3c (at 1.85 GHz) derived from corresponding voltage controlled oscillators 4a, 4b, 4c supplied with respective control voltages 5a, 5b, 5c. This addition is carried out in three single side band up-converters 6a, 6b, 6c, one for each channel. The composite output signal 7a, 7b, 7c from each up-converter is fed as one input to a corresponding one of three variable gain preamplifiers 8a, 8b, 8c, the outputs of which are combined in a three-way power combiner 9 and fed to a linearised multi-channel power amplifier 10.

The output of the power amplifier 10 is fed to the antenna 1 for transmission. This output includes components on the three channels and it is sampled by a coupling element 12 which, by inductive coupling, samples a small part of the output power of each channel. Hence, the coupling element 12 obtains a sampled signal 11 representative of the output power on each channel. This sampled signal 11 is split into three equal power components in a power splitter 13, the individual components (each of which is representative of the output power on all channels) being fed to respective power control receivers 14a, 14b, 14c to which are also fed the high frequency voltages 3a, 3b, 3c applied to the respective up-converters. In each power control receiver 14a, 14b, 14c, the high frequency voltage from the corresponding voltage controlled oscillator is subtracted from the composite signal to leave the base band signal for the corresponding channel, together with the composite signal for the other two channels.

The output of each power control receiver 14a, 14b, 14c is fed to a corresponding intermediate frequency filter 15a, 15b, 15c which removes the unwanted signals of the other two channels and filters out other unwanted components. The resulting baseband signals 16a,

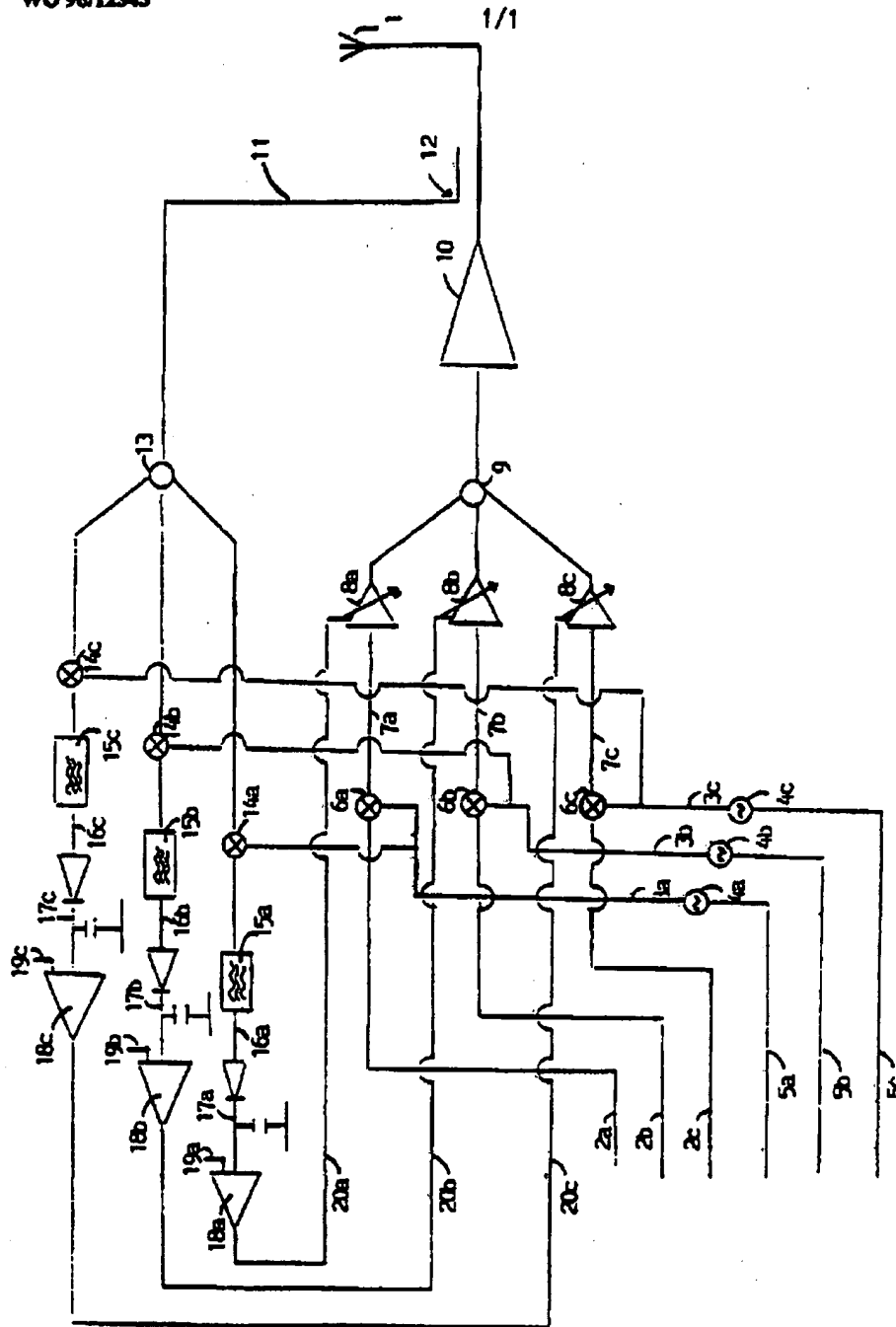
16b, 16c are fed through corresponding baseband demodulators 17a, 17b, 17c and applied as one input to an error amplifier 18a, 18b, 18c, the other input of which is a power control signal 19a, 19b, 19c. Each error amplifier 18a, 18b, 18c produces an output signal which is representative of the difference between its inputs and which constitutes a control signal 20a, 20b, 20c which is applied to the corresponding variable gain preamplifier 8a, 8b, 8c to alter its gain. Hence, the gain of each preamplifier 8a, 8b, 8c is continuously varied in dependence upon the output power of the multichannel power amplifier 10 for that channel, so that adaptive power control is used on each channel separately, using frequency selectivity. The closed loop power control system controls (with 2 dB power stepping) the plurality of radio channels being amplified.

The three channels are preferably channels operating according to the same standard or system, but the invention is applicable to channels of different systems. For example, the channel bearing the "a" suffixes could be GSM operating at 900 MHz, and the two other channels could be on a digital cellular system operating at 1.8 Giga Hz.

CLAIMS

1. A transmitter for a radio telephone base station, the transmitter being operative to transmit radio signals on at least two channels, the transmitter comprising a variable gain preamplifier for each channel, combining means for combining the outputs of the variable gain preamplifiers, a multichannel power amplifier for amplifying the output of the combining means, coupling means for sampling the output of the multi-channel power amplifier and for obtaining a sampled signal representative of the output power on each channel, and a feedback loop for applying to each variable gain preamplifier a control signal which is derived from the said sampled signal, whereby the gain of each preamplifier is varied in dependence upon the power level of each channel at the output of the multichannel power amplifier.
2. A transmitter according to claim 1 and including, for each channel, a mixer in which a baseband signal carrying the information of that channel is added to a high frequency control signal to provide a composite signal which is fed as an input to the corresponding preamplifier, whereby the sampled signal includes baseband and high frequency components for each channel.
3. A transmitter according to claim 2, wherein the feedback loop includes means for subtracting the high frequency control signal from the sampled signal to provide, for each channel, a baseband signal.
4. A transmitter according to claim 3, wherein said means are electrically connected to the inputs of the mixers so that the high frequency control voltage is derived from the input to the mixers.
5. A transmitter according to claim 3 or 4, where the feedback loop includes, for each

channel, an error amplifier the respective inputs of which are the baseband signal and a power control signal and the output of which is the control signal applied to the corresponding preamplifier.



INTERNATIONAL SEARCH REPORT

Int. and Application No.
PCT/GB 95/02409

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 H03G3/20

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H03G H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practised, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO,A,93 21700 (ERICSSON GE MOBILE COMMUNICAT) 28 October 1993 see page 4, line 25 - page 5, line 23; figure 1	1
A	WO,A,88 03342 (MOTOROLA INC) 5 May 1988 see page 9, line 4 - page 11, line 11; figure 1	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is used to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "Z" document member of the same patent family

Date of the actual completion of the international search

18 December 1995

Date of making of the international search report

23.01.96

Name and mailing address of the ISA
European Patent Office, P.O. 5118 Patentlaan 3
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tr. 31 431 epo nl.
Fax (+31-70) 340-3016

Authorized officer

Blaas, O-L

INTERNATIONAL SEARCH REPORT
information on patent family members

International Application No
PCT/GB 95/02409

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO-A-9321700	28-10-93	US-A- 5345598	06-09-94
		AU-B- 4026893	18-11-93
		BR-A- 9305476	11-10-94
		CA-A- 2111008	28-10-93
		EP-A- 0565505	13-10-93
		JP-T- 6511129	08-12-94
<hr/>			
WO-A-8803342	05-05-88	US-A- 4817192	28-03-89
		US-A- 4852086	25-07-89
		US-A- 4955083	04-09-90
<hr/>			

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☒ **BLACK BORDERS**
- ☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☐ **FADED TEXT OR DRAWING**
- ☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKEWED/SLANTED IMAGES**
- ☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☐ **GRAY SCALE DOCUMENTS**
- ☐ **LINES OR MARKS ON ORIGINAL DOCUMENT**
- ☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- ☐ **OTHER:** _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.